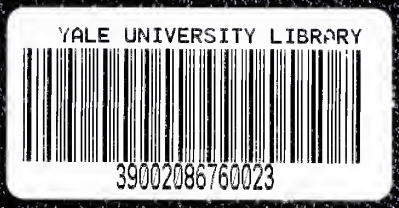

HIP FRACTURE OUTCOMES IN ELDERLY INDIVIDUALS

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ABSTRACT

Hip fractures are commonly occurring events with potentially devastating effects. Death, institutionalization, and decline in function are the major potential adverse outcomes following hip fractures. The 2806 participants in the Established Populations for Epidemiologic Studies in the Elderly (EPESE) program, a prospective community-based study of elderly men and women in New Haven, Connecticut, were monitored to determine the frequency of occurrence of hip fractures and their consequences: death, institutionalization, and alteration in function. Extensive information was collected before the fracture on physical and mental function, social support, and demographic features. Medical charts were reviewed and follow-up contacts were made to determine the occurrence of adverse outcomes.

Of the 2806 subjects, 120 sustained a hip fracture in six years. Of these 120, 22 (18.3%) died within six months of the event and 31 (25.8%) were in a nursing home at six months. Of the survivors at six months, only 6% had returned to their baseline function as measured on a 10 point scale including the following items: eating, bathing, dressing, toileting, grooming, transferring, walking across a room, doing heavy housework, climbing stairs, and walking one half mile (15% returned to baseline if mechanical assistance was allowed to perform these activities). The baseline factors which predicted the occurrence of death were poor mental status, a high number of complications during the hospitalization, male gender, and the site of the fracture. The baseline factors which predicted institutionalization at six months after the fracture were residence in a nursing home at the time of admission and poor mental status. The only

baseline factor which predicted functional decline at six months after the fracture was poor mental status.

This study was unique in its utilization of a prospectively followed cohort to determine the occurrence of hip fractures and their consequences, as well as the potential baseline factors associated with these consequences. Also, it was the first study to examine all three major potential adverse outcomes and the potential predictors of these outcomes.

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INTRODUCTION

Hip fractures occur frequently in elderly individuals and often have devastating effects on the lives of those who sustain them. Over 200,000 hip fractures occur in individuals age 65 and over in the United States every year at a cost of over seven billion dollars (1, 2). Older individuals and women are at greatest risk for hip fractures (3-6), with one study showing that by age 90, 32% of women and 17% of men will have sustained a hip fracture (6). Hip fractures are potentially catastrophic events with adverse outcomes including death, institutionalization, and alteration in function. This study will focus on these adverse outcomes.

The unique features of this study include the population evaluated and the prospective collection of baseline data prior to the occurrence of hip fracture. Subjects were derived from a prospectively followed community-living cohort of 2806 individuals age 65 and older living in New Haven, Connecticut in 1982. Participants who sustained a hip fracture between 1982 and 1988 were enrolled in the current study and were monitored for the occurrence of adverse events. Data on potential predictors of these outcomes such as physical function, mental function, social support, and demographic features were obtained prior to the fracture. The advantages of using this population and data collection method were that it was possible to determine the frequency of occurrence of death, institutionalization, and alteration in function in a representative elderly population and to determine if true baseline features could be found that predicted the occurrence of these adverse outcomes.

BACKGROUND

While there is an extensive literature on the incidence of hip fractures and the risk factors for occurrence, considerably less has been written about the potential consequences of the fracture such as death, long-term institutionalization, and alteration in function. Early studies of mortality often reflected surgical or anesthetic techniques or levels of medical support that differ from current standards or included nonsurgical cases in their analysis. With respect to institutionalization, many studies cite rates or reasons for discharge to nursing homes after the acute hospitalization for fracture, but few concentrate on the need for and reasons behind continued institutionalization. Function is defined differently in many studies, but most concentrate on one dimension, typically ambulation, as the outcome measure. This discussion will assess the literature in these three areas, but will concentrate on recent mortality studies (within the last 15 years), on studies addressing the need for long-term institutionalization, and on studies with a multidimensional functional outcome plus an assessment of risk factors.

MORTALITY

Several recent studies on mortality following hip fracture are outlined in Table 1. The 6 month mortality rates range from 12.6% to 44% (with most between 12-22%) and 12 month mortality rates between 7.8% and 27%. Although these numbers seem incongruous with a wider range at 6 months, patient selection differs among studies. Studies which select healthier patients at baseline may be expected to have lower rates than those that include all patients. Thus, Mossey et al. (17) included only high functioning women and found the lowest one year mortality rate. Even within these

recent studies of mortality, there is a great deal of methodological variability. Many of these studies are retrospective and have relatively little baseline information on subjects. Other elements that may affect the varying mortality rates are where and when the study was done. Two studies that were carefully executed and provided data on risk factors for mortality were Kenzora (13) and Magaziner (16). Kenzora et al. followed 406 patients at one hospital who sustained a hip fracture over a seven year period. Patients were followed until death or at least one year after fracture. They found a 14.3% one year mortality and noted that the number of comorbid illnesses, the number of postoperative complications and the timing of surgery were the key risk factors for mortality. They did not report a six month mortality rate and the risk factors evaluated were from the perioperative period and did not account for preoperative mental or physical function or social factors. Magaziner et al. concentrated on patients 65 and older and did account for a few more baseline features, but mental status was determined by chart report of dementia or delirium rather than actual testing. They found mortality rates of 12.6% at six months and 17.4% at one year (similar to Kenzora). The presence of delirium (but not dementia) at the time of admission and comorbid illnesses were associated with mortality. In summary, previous studies have noted that age, gender, baseline residence in a nursing home, mental status and medical condition (comorbid illnesses and postoperative complications) are associated with mortality after hip fracture (Table 1).

INSTITUTIONALIZATION

Scant information is available on the risk of long-term institutionalization following hip fracture. Much of the literature concentrates on the difference in rates of long-term institutionalization before and after implementation of prospective payment systems (PPS) in 1983. Fitzgerald noted in two studies (18, 19), one in a municipal teaching hospital with an indigent population and the other in a community hospital, that the rates of institutionalization increased after the implementation of PPS, from 13% to 39% (18) at six months and from 9% to 33% (19) at one year, respectively. However, two other studies found relatively little difference before and after PPS implementation. Gerety et al. (20) found that 41% were in an institution at one year after PPS compared with 42% before (although a greater percentage were in skilled nursing rather than residential care facilities). Palmer et al. (21) found that in a group of 386 Medicare patients there was no significant difference in institutionalization rates at six months post fracture before and after PPS (22.6% v. 19.9%). Although risk factors for long-term institutionalization were not specifically determined in these studies, Fitzgerald did note that patients without assistance at home were more likely to remain in a nursing home and Gerety noted that patients discharged to a rehabilitation facility were more likely to return home. Two other studies focused more on function than on finance and also determined risk factors for long-term institutionalization. Ceder et al. (22) studied 103 patients admitted from home (mean age 75, 73% female) and found that 18.2% of survivors were institutionalized at four months and 14.3% at one year. The factors that were related to continued institutionalization were high comorbidity, living alone, and delayed ambulation after the fracture. Bonar et al. (23) studied 151 elders originally

living in the community who were discharged to a nursing home and determined what percentage eventually returned home and what factors influenced this return. Thirty-three percent of patients remained in a nursing home at six months and the main risk factors for this were older age, disorientation, dependence in ADL performance, lack of family involvement, and fewer physical therapy hours available at the nursing home. In summary, age, health, physical and mental function, and social support have been shown to be potentially important contributors to long-term institutionalization.

FUNCTION

Previous studies of function that addressed a range of measures (some element of basic or instrumental activities of daily living [ADL/IADL] or higher level function in addition to ambulation) and determined which baseline factors were associated with post fracture function are outlined in Table 2. Katz et al. (26) performed an early study in a rehabilitation setting and found that many patients returned to prefracture levels of function by six months (23.8% walking, 43.1% ADL). Two studies had very selective entry criteria which may affect the generalizability of recovery and risk factor data. Cobey et al. (24) assessed the ADL function at six months of 89 hip fracture patients who had been highly independent, cognitively intact, and free of disease prior to the event. They found that less than one quarter had a major change in function while the remainder experienced a complete or partial recovery which reflected no change in their lifestyle. In a similarly high functioning group of 196 women, Mossey et al. (28) found that many did not return to baseline levels of function in selected ADL, IADL, and ambulation, although little data are presented to define what patients could do before and

after the fracture. Magaziner et al. (27) used less selective criteria (patients were admitted from the community), but relied heavily on proxy interviews to determine how patients were functioning before and after the event (nearly 40% were proxy). They did look at a wider range of outcomes including complete lists of basic and instrumental ADL, as well as ambulation. They found that 20-40% of individuals returned to baseline levels in these areas at two months with another 1-1/2 to 2 fold improvement by six months (although the actual numbers were not given). Between 6 months and 1 year after the fracture, however, there was no further recovery in function. In the most extensive assessment of functional outcomes, Jette et al. (25) performed an intervention trial to see if an intensive rehabilitation program would alter recovery patterns (it did not). They found that at least half of the patients returned to baseline levels of indoor and outdoor walking and stair climbing in one year. Additionally, 20-33% returned to baseline levels of numerous basic and instrumental ADL and social/role items. Thus, although each of these studies defined outcome function somewhat differently, they all found a prominent decline after fracture, but a substantial recovery as well at six months or one year. Old age and impaired mental or physical function before or at the time of fracture were commonly cited risk factors for limited recovery in these studies. Some also noted that medical and social factors played a role as well.

Based on the previous literature cited here, the potential strengths of the current study are apparent. It offers a breadth and depth of baseline information comparable to the most exhaustive of these studies and far in excess of most. Also, it is the only study which has true prefracture baseline data on potential predictors, as compared to information obtained after the event regarding prefracture status. It includes a wide

range of patients, all of whom started out as community dwellers at the inception of the cohort, but many of whom were admitted to the hospital from nursing homes at the time of fracture. The outcomes assessed run the gamut of the major adverse effects of hip fractures, including death, long-term institutionalization, and alteration in physical function. The latter measure encompasses a range of activities from basic ADL to walking a half mile. The details of subject selection, baseline information, and outcome assessment will be provided in the next section.

TABLE 1: SUMMARY OF LITERATURE ON MORTALITY FOLLOWING HIP FRACTURE

Author	Subjects	Mortality	In Hosp	1 Mo.	3 Mo.	6 Mo.	12 Mo.	Risk Factors
McCown 1976 (7)	n = 117, 37% from NH		7.6%			17.9%	25%	Age, NH Residence at baseline
Baker 1978 (8)	n = 50, over age 65					44%		Poor mental status
Miller 1978 (9)	n = 360, mean age 73, 71% female						27%	Old age, cerebral dysfunction, male gender
Jensen 1979 (10)	n = 1592, mean age 77		8.6%		17%	21.5%	26.8%	(inhospital mortality: age, gender)
Jensen 1979 (11)	n = 518, mean age 78, 80.5% female					15.6%		prefracture social function
Dahl 1980 (12)	n = 675, 74% female		13.9%	17.1%		21.0%		age, male gender, comorbid illness
Kenzora 1984 (13)	n = 406						14%	comorbid illnesses, timing of surgery, postoperative complications
Holmberg 1986 (14)	n = 3002, intracapsular fractures				12%			NH residence at baseline, age, male gender

Author	Subjects	Mortality	In Hosp	1 Mo.	3 Mo.	6 Mo.	12 Mo.	Risk Factors
White 1987 (15)	n = 241, mean age 75.4, 75% female						22%	male gender, high operative risk, timing of surgery, young age (based on standard mortality ratio)
Magaziner 1989 (16)	n = 814, age 65+, community living before fracture		4.3%		8.2%	12.6%	17.4%	comorbid illness, delirium
Mossey 1989 (17)	n = 211, 100% female, mean age 78, community living						7.8%	postoperative cognitive function, self-rated health

TABLE 2: SUMMARY OF LITERATURE ON CHANGE IN FUNCTION AFTER HIP FRACTURE

Author	Subjects	Outcomes	Risk Factors
Cobey et al, 1976 (24)	89 patients age 65+ who survived 6 months post fracture; acute hospital; independent before fracture (care for self, walk 300 yards, climb 6 steps, free of leg or mental impairments, no significant systemic disease, stable fracture repair)	Performance in walking, bathing, dressing, toileting, transferring at 6 months compared with report of prefracture function (95% perfect score at baseline); 23.6% poor (major change in function), 52.8% partial (minor change, but lifestyle unaffected), 23.6% complete recovery	Prehospitalization: age, getting out of home In hospital: mental clarity, emotional state Physical Therapists predicted outcome best based on balance, coordination, stamina, motivation, and mental clarity.
Jette et al, 1987 (25)	75 hip fracture patients at acute hospital assigned to standard or intensive rehabilitation programs	% regaining prefracture levels in 1 year: 53-79% indoor walking, 50-54% outdoor walking, 49-54% climbing stairs 33% basic ADL (indoor walking, bed-chair transfer, toilet transfer, put on socks/shoes) 21% IADL (stairs, outdoor walking, tub transfers, meals, dishes, light housework) 26% social/role items (shopping, carrying bundle, visiting, caring for others, transportation, community activities)	Outcome = summary of disabilities 6 month = old age, fracture site, discharge to nursing home (NH), poor emotional state 1 year = prefracture function, complications, discharge to NH/rehabilitation hospital

Author	Subjects	Outcomes	Risk Factors
Katz et al, 1964 (26)	130 consecutive patients admitted to rehabilitation facility within 6 months of fracture	70% partial or complete recovery of walking ability in 6 months. 43.1% complete recovery of baseline ADL performance in 6 months	Prefracture need for mechanical or personal assistance with walking, old age, comorbid illnesses
Magaziner et al, 1990 (27)	536 patients age 65+ who survived 1 year; acute hospital; from community; chart review and patient/proxy interview (340 patient and 196 proxy interviews had complete follow-up)	1) PADL (basic ADL and walking) 2) IADL (medications, telephone, transportation, shopping, cooking, housework, finances) 3) Walking % Fully Independent: Baseline / 1 Year Walking 86.5% / 53.9% PADL 70.4% / 39.8% IADL 33.9% / 14.0% % Returning to Prefracture Level of Function at 2 Months: Walking 40% PADL 25% IADL 18%	Walking -- old age, dementia, delirium, low contact with social network PADL -- old age, dementia, delirium, long length of stay (LOS), falls, low contact with social network, few physical therapy sessions IADL -- old age, dementia, delirium, long LOS, falls, small social network, low contact with network

Author	Subjects	Outcomes	Risk Factors
Mossey et al, 1989, 1990 (17, 28)	196 women who survived 1 year after fracture, mean age 78; before fracture: community dwelling, could walk across room, no predisposition to pathologic fracture; no apparent postsurgical cognitive impairment	Ambulation: 20% at 1 year v. 81% at baseline walking with no more than a cane. Physical function: 7 items (bathe, dress, shop, housework, pull/carry objects, ambulate) 28% back to baseline in 5/7 categories at 1 year, 22% not back to baseline in at least 4/7	Age, postoperative cognition, prefracture physical function, postoperative depression

METHODS

1.) Subjects

Subjects were drawn from the Yale Health and Aging Project (YHAP), one of four sites funded by the National Institute on Aging (NIA) as part of the EPESE program. This cohort of 2806 individuals was derived from a probability sample of noninstitutionalized men and women age 65 years and older living in New Haven, Connecticut in 1982. The probability sample was stratified by housing type with an oversampling of men. Details of the sampling design have been described previously (28). The resulting cohort consisted of 1641 women and 1165 men from diverse ethnic, racial, and social backgrounds (29).

There was ongoing surveillance of the cohort for death, hospitalization, and entry into nursing homes. Death was determined from local newspaper obituaries and city and state death clearance searches yielding very accurate surveillance. The two New Haven hospitals, Yale New Haven and Saint Raphael, accounted for the vast majority of hospitalizations among EPESE participants. A nurse-interviewer monitored these hospitals weekly from the onset of the EPESE project until October 31, 1988 and all respondents with a discharge diagnosis of hip fracture were enrolled in the current study.

2.) Information Sources

All EPESE respondents underwent in-house interviews every three years (1982, 1985, 1988) and phone interviews in intervening years (1983, 1984, 1986, 1987). These were performed by trained interviewers and stringent follow-up procedures were maintained. During these interviews extensive information was collected on physical function, mental function, social support, and demographic features. In addition, all

subjects sustaining a hip fracture had information extracted directly from the medical record by a project nurse on hip fracture site, complications, in-hospital death, comorbid diagnoses, and place of residence. These subjects also had follow-up phone interviews at six weeks and six months performed by the same project nurse.

3.) Variables

Information was collected on a variety of predictor (independent) premorbid and perievent variables (Table 3), as well as outcome (dependent) variables (Table 4). Demographic features such as gender, race, marital status and age were determined for the initial 1982 interview (marital status was updated yearly). Behaviors such as smoking (current, past, never) and alcohol use (number of ounces per month) were also determined from the 1982 interview.

Cognitive ability was assessed by the ten-item Short Portable Mental Status Questionnaire developed by Pfeiffer (30) and came from the most recent three-year interview. This was analyzed as both a continuous (0 to 10 errors) and a dichotomous (four or more versus three or less errors) variable.

Depressive symptoms were assessed by the Center for Epidemiologic Studies - Depression (CES-D) scale (31). This 20 item self-report measure was performed during each three year interview and the most recent interview prior to the fracture was used here. This was analyzed as both a continuous (0 to 60 score) and a dichotomous (16 or more [depressed] versus less than 16 [not depressed]) variable.

Physical function was assessed for self-report items derived from the work of Katz (33), and Rosow and Breslau (34). These 10 items included: basic activities of daily living and mobility items such eating, toileting, grooming, transferring, bathing,

dressing, walking across a room; and higher level function items such as climbing a flight of stairs, walking a half mile and performing heavy housework (able or not able to perform). Basic ADL were scored two ways: no help or mechanical assistance only needed versus personal assistance required or unable to do; and no help versus any help needed or unable to do. These distinctions were made because there are different ways of viewing change in function. From one perspective, all that matters is if a person can perform the activity, with or without a device. Another perspective views the need for assistance of any kind to perform the activity as a decline for someone who did not require such assistance beforehand. Information on all of these came from the most recent yearly interview. The ten physical function items were analyzed as a continuous variable with potential scores ranging from 0 to 10 (one point per item able to perform) and were also grouped into tertiles based on participation, with levels of 0 to 6 (low), 7 to 8 (moderate), and 9 to 10 (high) items.

A social activity scale was developed based on participation in activities of a less physical nature that involve social interaction rather than physical exertion. These included: playing cards, games or bingo; attending movies, restaurants or sporting events; participation in groups; attending religious services; performing paid work or volunteer work; and taking trips. Information came from the most recent three year interview and was scored as a continuous (0 to 7) and a dichotomous variable (participation in one or less versus two or more activities).

Social networks and support were assessed by measuring the number of social contacts and their availability to provide support. The number of ties with friends, relatives, and children the respondent felt close to constituted the network size measure.

The need for and the number of sources available to provide emotional and instrumental (help with tasks) support were determined. These were categorized into three levels: no need for support; need support, but no sources; need support and one or more sources available. Information was from the most recent three year interview.

All of the above information was derived from the YHAP questionnaire and interviews prior to the occurrence of hip fractures. At the time of the fracture, additional information was collected from medical record abstraction. This included where the patient lived prior to hospitalization (at home or in a nursing home). Also, the presence of comorbid diagnoses was determined, although no information on the severity of the condition was obtained. A scale was constructed from those items likely to impact on function or mortality: angina, arrhythmias, cancer, stroke, chronic obstructive pulmonary disease or emphysema, congestive heart failure, dementia, diabetes, myocardial infarction, and peripheral vascular disease. This was analyzed both as a continuous (0 to 10) and a dichotomous (zero to one versus two or more conditions present) variable.

The site of the hip fracture was recorded and grouped into femoral neck (neck, base of neck, intracapsular, mid cervix), intertrochanteric, and subtrochanteric. The number of complications encountered during the hospitalization was also recorded (fever, pneumonia, hematoma, pressure sore, pulmonary embolus, thrombophlebitis, urinary tract infection, wound infection or other complication) and analyzed as none, one, or two or more complications present and as a continuous variable (number of complications).

The major potential adverse outcomes following hip fractures are death, institutionalization, and alteration in function. Death was assessed in the hospital or until

six months after the fracture. Institutionalization was defined as residence in a nursing home at six months after the fracture. Physical function was assessed at both six weeks and six months after the fracture. The same ten point scale was used to measure function at baseline, six weeks, and six months (eating, toileting, grooming, transferring, bathing, dressing, walking across a room, doing heavy housework, climbing a flight of stairs and walking a half mile). These activities were chosen because they reflected the range of function and level of mobility expected in a community-living population and because they are commonly used measures of physical function. The scale was scored as a continuous variable ranging from zero (participation in none of the activities) to ten (participation in all the activities).

4.) Analysis

The frequency of occurrence of hip fracture and adverse outcomes such as death and institutionalization were determined. Bivariate analyses were performed assessing the relationship between premorbid predictors and death and institutionalization. Stratified bivariate analysis for nursing home residence at baseline was also performed. Multiple logistic regressions were performed separately for death and institutionalization.

Physical function at six weeks and six months were determined and these were compared with the baseline level of function prior to the fracture to identify any changes in level of function. For logistic regressions a stepwise algorithm of predictors was created to determine a final model. Variables were added in the following order with those reaching statistical significance ($p < .10$) remaining in the model: demographic features (nursing home at baseline, age, gender, race, education); physical factors (complications, site of fracture, comorbid illnesses, physical function); mental function

(mental status, depression); social support (network size, emotional support, instrumental support, social activity scale, marital status); behaviors (smoking and alcohol use). The final model included all those significant at this point and those significant in bivariate analyses. These analyses were performed on both the 0-10 function scales and on a measure of change in function. This measure of change was calculated according to the formula: % change = (baseline function - function at six weeks or six months) * 100/baseline function. These analyses were carried out for function at six weeks and six months. Multiple linear regression was performed for each time point to assess the effects of the predictor variables. Also, bivariate analyses with mean function scores at six weeks and six months were calculated for dichotomous premorbid predictors. To assess change in function directly, 10 by 10 tables were created comparing function at six weeks and six months to baseline. These analyses were carried out on the two different ways of measuring function (including or excluding the use of a mechanical device, as described above). Analyses were performed using SAS software.

TABLE 3: INDEPENDENT VARIABLES

Baseline Factors

I. Demographic features: age, gender, race, education, nursing home residence

II. Physical factors:

- fracture site
- comorbid diagnoses -- number present: angina, arrhythmias, cancer, stroke, COPD, CHF, dementia, diabetes, MI, peripheral vascular disease
- complications -- number present: fever, pneumonia, hematoma, pressure sore, pulmonary embolus, thrombophlebitis, UTI, wound infection, other

- physical function -- eat, toilet, groom, transfer, bathe, dress walk across a room, do heavy housework, climb one flight of stairs, walk one half mile -- scored on 0-10 scale with one point given for every item performed independently or with mechanical assistance only.

III. Mental factors:

- mental status -- number of errors (0-10) on Pfeiffer Short Portable Mental Status Questionnaire (31)
  (4 or more errors abnormal)
- depressive symptoms -- Centers for Epidemiologic Studies Depression Scale (32) scored on a 0-60 scale
  (16 or more consistent with depression)

IV. Social networks and support:

- size of social network -- number of ties with friends, relatives, children respondent felt close to
- emotional support -- need for and availability of someone to discuss problems and help make decisions
- instrumental support -- need for and availability of someone to help with daily tasks
- marital status
- social activities -- number participated in: cards/games/bingo, movies/restaurants/sporting events, day/overnight trips, groups, religious services, volunteer work, paid work

V. Behaviors: alcohol use, smoking

TABLE 4 - DEPENDENT VARIABLES

OUTCOME VARIABLES

- Death in first 6 months
- Nursing home residence at 6 months
- Function at 6 weeks and 6 months

  a) absolute score on 10 item scale at 6 weeks and 6 months (dress, transfer, toilet, groom, eat, bathe, walk across a room, do heavy housework, climb one flight of stairs, walk one half mile)

  b) change in function at 6 weeks and 6 months compared with baseline

$$\% \text{ change} = \frac{[\text{baseline function (0-10 score)} - \text{function at 6 weeks (0-10 score)}]}{\text{baseline function (0-10 score)}} * 100$$

RESULTS

In six years of follow-up, 120 subjects (4.3%) sustained a hip fracture. Of these 120 subjects, 22 (18.3%) died within six months of the fracture. Follow-up information was obtained on 84 individuals at six weeks and 83 at six months (15 refused follow-up interviews).Of the 83 subjects still alive at six months and for whom information was available, 31 (37.3%) were in nursing homes.

In bivariate analysis, a high number of comorbid diagnoses, male gender, a high number of errors on mental status testing, a high number of complications after the fracture, and the site of the fracture were all significantly associated with death (Table 5). In analyses stratified by nursing home residence at baseline, the same five predictors were associated with death. In multiple logistic regression, gender, complications, mental status, and site (femoral neck v. intertrochanteric) remained associated with death (Table 6).

In bivariate analysis, residence in a nursing home at baseline, poor mental status, and poor physical function were associated with nursing home residence at six months (Table 7). In analyses stratified by nursing home residence at baseline, only poor mental status was significantly associated with nursing home residence at six months. In multiple logistic regression, baseline mental status was the only significant predictor of institutionalization at six months for those subjects living in the community at baseline (Table 8).

The use of 10x10 tables comparing baseline function to function at six weeks or six months allows for a visual depiction of change in function after hip fracture. The 10x10 tables (allowing for mechanical assistance) show that only 10.7% returned to their

baseline level of physical function, while one third had a profound decline at six weeks (scored 7-10 at baseline, but scored 0-3 at six weeks) (Table 9). These same trends are evident at six months, but are less pronounced, suggesting a slight improvement in function over that time (only 14.5% returned to baseline level, while 23.9% scored 7-10 at baseline and 0-3 at six months) (Table 10). This decline in function is even more pronounced if one does not allow for mechanical assistance and considers those who can perform the activities without help versus those who require any help or who are unable. In this case, only 4.8% return to baseline at six weeks and an astounding 64.3% who performed 7-10 items at baseline can only perform 0-3 at six weeks (Table 11). Again, there is a slight improvement at six months with 6.0% returning to baseline, while 46.6% of those performing 7-10 items at baseline could perform only 0-3 at six months (Table 12).

Table 13 shows the results of bivariate analysis of function. Although complex, this table provides a comprehensive depiction of differences between function at baseline, six weeks, and six months. Depicted are the mean physical function scores (0-10 scale score with one point for each item performed independently or with mechanical assistance) at baseline, six weeks, and six months for each category of baseline factor (i.e., mean six week function for males versus females). This demonstrates the clear decline in function at both time points after the fracture and also shows the slight improvement from six weeks to six months. At six weeks and six months, statistically significant differences for mean function scores were found between categories of several baseline factors. Individuals who at baseline had poor physical function, poor mental status, low social activity levels, who never smoked, who resided in a nursing home, or

who had no complications during their hospitalization all had significantly lower mean function levels at six weeks than their counterparts. Individuals who at baseline had poor physical function, poor mental status, who never smoked or who resided in a nursing home had significantly lower mean function levels at six months than their counterparts.

In addition to these changes in absolute scores on the physical function scale, the right half of Table 13 depicts the mean percentage change in scale scores from baseline to six weeks and six months. This demonstrates the magnitude of decline in function at these time points compared to baseline levels. Individuals who at baseline had poor mental status, low education levels, who were nonsmokers or who resided in nursing homes had a significantly greater percentage decline from baseline at six weeks than their counterparts. Individuals who at baseline had poor mental status had a significantly greater decline at six months than their counterparts.

Poor mental status and poor physical function were the only baseline factors predictive of poor function at six weeks in a multiple linear regression model, while poor mental status and nonsmoking status were the only predictors of poor function at six months. Only poor mental status was associated with percentage decline in function from baseline to six weeks and six months (Table 14).

TABLE 5a: PROPORTION OF SUBJECTS DYING WITHIN SIX MONTHS OF HIP FRACTURE BY BASELINE DEMOGRAPHIC AND BEHAVIORAL FEATURES

BASELINE FACTOR		% DEAD (N)	RR (95% CI)
I. *Demographics*			
AGE	85+	27.3 (22)	
	75-84	16.1 (62)	
	65-74	16.7 (36)	
GENDER	Male	35.3 (34)	3.04 (1.45,6.36)
	Female	11.6 (86)	
INSTITUTIONALIZATION	Yes	27.3 (22)	
	No	16.5 (97)	
RACE	Nonwhite	21.4 (14)	
	White	18.1 (105)	
EDUCATION	$\leq$8 years	23.3 (60)	
	$\geq$9 years	11.8 (51)	
II. *Behaviors*			
ALCOHOL USE	$\geq$ 9oz/mo	17.7 (17)	
	1-8 oz/mo	25.9 (27)	
	0	15.5 (71)	
SMOKING	current	15.4 (26)	
	former	22.2 (27)	
	never	16.9 (65)	

‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 5b: PROPORTION OF SUBJECTS DYING WITHIN SIX MONTHS OF HIP FRACTURE BY BASELINE PHYSICAL AND MENTAL FUNCTION

BASELINE FACTOR		% DEAD (N)	RR (95% CI)
III. *Physical*			
COMPLICATIONS (# in hospital)**	≥2	40.0 (20)	
	1	25.7 (35)	
	0	7.7 (65)	
SITE OF FRACTURE‡	Femoral Neck	24.4 (45)	
	Trochanteric	8.6 (58)	
	Subtrochanteric	33.3 (6)	
COMORBIDITY (# conditions)**	2+	33.3 (42)	3.25 (1.49,7.12)
	0-1	10.3 (78)	
BASELINE FUNCTION (0-10 scale)	0-6	16.0 (25)	
	7-8	19.5 (41)	
	9-10	15.4 (52)	
IV. *Mental*			
MENTAL STATUS‡ (# errors on SPMSQ)	4+ errors	28.6 (28)	2.16 (.97,4.82)
	0-3 errors	13.3 (83)	
DEPRESSION (CESD score)	16+	22.7 (22)	
	<16	14.3 (12)	

‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 5c: PROPORTION OF SUBJECTS DYING WITHIN SIX MONTHS OF HIP FRACTURE BY BASELINE SOCIAL NETWORKS AND SUPPORT

BASELINE FACTOR		% DEAD (N)	RR (95% CI)
V. *Social Support*			
NETWORK SIZE (# ties)	0-4	15.0 (40)	
	5-7	21.2 (33)	
	≥8	13.9 (36)	
EMOTIONAL SUPPORT	no need	19.1 (21)	
	no source	15.4 (13)	
	>1 source	16.2 (74)	
INSTRUMENTAL SUPPORT	no need	12.5 (8)	
	no source	9.1 (11)	
	>1 source	17.8 (90)	
MARITAL STATUS	not married	16.8 (95)	
	married	23.8 (21)	
SOCIAL ACTIVITY INDEX (0-7 scale)	0-1	19.2 (52)	
	2+	17.7 (62)	

‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 6: MULTIPLE LOGISTIC REGRESSION: BASELINE FACTORS SIGNIFICANTLY ASSOCIATED WITH DEATH FOLLOWING HIP FRACTURE

Baseline Factors

	p	β Coefficient	adj OR	95% CI
Gender (male v. female)	.02	1.92	6.82	(1.34, 34.78)
Complications (increasing #) 0-9 scale per unit increase	.001	-1.79	.17	(.06, .49)
Comorbidity (increasing # conditions) 0-10 scale per unit increase	.22	- .39	.68	(.36, 1.26)
Mental Status (increasing# of errors) 0-10 scale per unit increase	.02	- .36	.70	(.51, .95)
Site				
(subtroch v. intertroch)	.91	.11	1.12	(.14, 8.64)
(intertroch v. fem neck)	.02	-1.64	.19	(.05, .78)

TABLE 7a: PROPORTION OF SUBJECTS INSTITUTIONALIZED SIX MONTHS AFTER HIP FRACTURE BY BASELINE DEMOGRAPHIC AND BEHAVIORAL FEATURES

BASELINE FACTOR		% IN NH (N)	RR (95% CI)
I. *Demographics*			
AGE	85+	40.0 (15)	
	75-84	35.6 (45)	
	65-74	39.1 (23)	
GENDER	Male	33.3 (18)	
	Female	38.5 (65)	
INSTITUTION-ALIZED**	Yes	100 (15)	4.11 (2.73,6.42)
	No	23.7 (67)	
RACE	Nonwhite	60.0 (10)	
	White	34.7 (72)	
EDUCATION	$\leq$8 years	33.3 (31)	
	$\geq$9 years	36.8 (38)	
II. *Behaviors*			
ALCOHOL USE	$\geq$ 9oz/mo	16.7 (12)	
	1-8 oz/mo	33.3 (15)	
	0	44.2 (52)	
SMOKING	current	23.5 (17)	
	former	29.4 (17)	
	never	45.8 (48)	

‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 7b: PROPORTION OF SUBJECTS INSTITUTIONALIZED SIX MONTHS AFTER HIP FRACTURE BY BASELINE PHYSICAL AND MENTAL FUNCTION

BASELINE FACTORS		% IN NH (N)	RR (95% CI)
III. *Physical*			
COMPLICATIONS (# in hospital)	≥2	33.3 (12)	
	1	29.2 (24)	
	0	12.6 (27)	
SITE OF FRACTURE	Femoral Neck	32.3 (31)	
	Trochanteric	44.2 (43)	
	Subtrochanteric	66.7 (3)	
COMORBIDITY (# conditions)	2+	34.8 (23)	
	0-1	38.3 (60)	
BASELINE FUNCTION* (0-10 scale)	0-6	68.8 (16)	
	7-8	32.3 (31)	
	9-10	27.8 (36)	
IV. *Mental*			
MENTAL STATUS** (# errors on SPMSQ)	4+ errors	79.0 (19)	3.27 (1.96,5.46)
	0-3 errors	24.1 (58)	
DEPRESSION (CESD score)	16+	50.0 (14)	
	<16	32.8 (61)	

‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 7c: PROPORTION OF SUBJECTS INSTITUTIONALIZED SIX MONTHS AFTER HIP FRACTURE BY BASELINE SOCIAL NETWORKS AND SUPPORT

BASELINE FACTOR		% IN NH (N)	RR (95% CI)
V. *Social Support*			
NETWORK SIZE (# ties)	0-4	30.0 (30)	
	5-7	36.4 (22)	
	≥8	40.0 (25)	
EMOTIONAL SUPPORT	no need	38.5 (13)	
	no source	63.6 (11)	
	>1 source	30.8 (52)	
INSTRUMENTAL SUPPORT	no need	42.9 (7)	
	no source	25.0 (8)	
	>1 source	37.1 (62)	
MARITAL STATUS	not married	38.8 (67)	
	married	23.1 (13)	
SOCIAL ACTIVITY INDEX (0-7 scale)	0-1	39.5 (38)	
	2+	36.6 (41)	

‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 8: MULTIPLE LOGISTIC REGRESSION: BASELINE FACTORS SIGNIFICANTLY ASSOCIATED WITH INSTITUTIONALIZATION AT 6 MONTHS AMONG COMMUNITY-LIVING SUBJECTS

Baseline Factors	p	β coefficient	adj OR	95% CI
Physical Function 0-10 score per unit increase	.86	-.04	.96	(.62, 1.50)
Mental Status (increasing # errors) 0-10 score per unit increase	.02	-.32	.73	(.56, .94)

TABLE 9: 10x10 TABLE OF FUNCTION SCORE (ON 0-10 SCALE) AT BASELINE COMPARED WITH SIX WEEKS AFTER HIP FRACTURE (WITH MECHANICAL ASSISTANCE ALLOWED)*

FUNCTION AT 6 WEEKS

10	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	2	2	2
7	-	-	-	-	-	-	-	3	6	5	1
6	-	-	-	-	-	-	2	3	1	3	3
5	-	-	-	-	-	-	-	2	1	2	3
4	-	-	-	-	-	-	-	2	-	1	2
3	-	-	-	-	-	1	1	1	-	1	3
2	-	-	-	-	-	1	1	1	1	2	1
1	2	-	-	1	-	1	-	-	2	1	1
0	-	3	-	3	-	-	2	5	-	2	1
	0	1	2	3	4	5	6	7	8	9	10
n =	2	3	0	4	0	3	6	17	13	19	17=84

BASELINE FUNCTION

% functioning at or above baseline (diagonal) at 6 weeks = 9/84 = 10.7%

22/66 (33.3%) scored 7-10 at baseline and 0-3 at 6 weeks

* score on 0-10 physical function scale with 1 point given for each of 10 items performed with no help or mechanical assistance (eat, toilet, groom, transfer, bathe, dress, walk across a room, do heavy housework, climb one flight of stairs, walk one half mile)

TABLE 10: 10x10 TABLE OF FUNCTION SCORE (ON 0-10 SCALE) AT BASELINE COMPARED WITH SIX MONTHS AFTER HIP FRACTURE (WITH MECHANICAL ASSISTANCE ALLOWED)*

FUNCTION AT 6 MONTHS

10	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	2	-	1
8	-	-	-	-	-	-	-	-	-	3	-
7	-	-	-	-	-	-	-	5	5	6	4
6	-	-	-	-	-	1	2	2	5	1	4
5	1	-	-	-	-	-	-	3	-	3	5
4	-	-	-	-	-	1	1	1	1	-	-
3	-	-	-	-	-	1	-	2	-	2	-
2	-	-	-	1	-	1	1	-	1	1	-
1	1	-	-	2	-	-	-	2	-	3	-
0	-	2	-	1	-	-	-	1	1	1	2
	0	1	2	3	4	5	6	7	8	9	10
n =	2	2	0	4	0	4	4	16	15	20	16=83

BASELINE FUNCTION

% functioning at or above baseline (diagonal) at 6 months = 12/83 = 14.5%

16/67 (23.9%) scored 7-10 at baseline and 0-3 at 6 months

* score on 0-10 physical function scale with 1 point given for each of 10 items performed with no help or mechanical assistance

TABLE 11: 10x10 TABLE OF FUNCTION SCORE (ON 0-10 SCALE) AT BASELINE COMPARED WITH SIX WEEKS AFTER HIP FRACTURE (MECHANICAL ASSISTANCE NOT ALLOWED)*

FUNCTION AT 6 WEEKS

10	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	1	2	-	1
6	-	-	-	-	-	-	-	-	1	3	-
5	-	-	-	-	-	-	1	-	1	-	2
4	-	-	-	-	-	1	2	1	1	4	3
3	-	-	-	-	-	1	3	3	2	3	4
2	-	-	-	-	1	1	3	1	2	4	3
1	2	1	-	2	1	-	-	1	2	-	3
0	-	3	1	3	-	-	2	4	-	3	1
	0	1	2	3	4	5	6	7	8	9	10
n =	2	4	1	5	2	3	11	11	11	17	17=84

BASELINE FUNCTION

% functioning at or above baseline (diagonal) at 6 weeks = 4/84 = 4.8%

36/56 (64.3%) scored 7-10 at baseline and 0-3 at 6 weeks

* score on 0-10 physical function scale with 1 point given for each of 10 items performed independently (without assistance)

TABLE 12: 10x10 TABLE OF FUNCTION SCORE (ON 0-10 SCALE) AT BASELINE COMPARED WITH SIX MONTHS AFTER HIP FRACTURE (MECHANICAL ASSISTANCE NOT ALLOWED)*

FUNCTION AT 6 MONTHS

10	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-	-	-	1
8	-	-	-	-	-	-	-	-	1	1	-
7	-	-	-	-	-	-	-	-	1	2	1
6	-	-	-	-	-	-	-	-	-	1	1
5	1	-	-	-	-	-	1	3	3	2	1
4	-	-	-	-	1	-	1	-	4	4	5
3	-	-	-	-	-	2	4	3	2	2	3
2	-	1	-	-	-	-	4	2	1	1	2
1	1	-	1	3	-	-	-	2	-	4	-
0	-	2	-	1	2	-	-	2	-	1	2
	0	1	2	3	4	5	6	7	8	9	10
n =	2	3	1	4	3	2	10	12	12	18	16=83

BASELINE FUNCTION

% functioning at or above baseline (diagonal) at 6 months = 5/83 = 6.0%

27/58 (46.6%) scored 7-10 at baseline and 0-3 at 6 months

* score on 0-10 physical function scale with 1 point given for each of 10 items performed independently (without assistance)

TABLE 13a: MEAN FUNCTION SCORES (ON 0-10 SCALE)† AND MEAN PERCENTAGE DECLINE IN FUNCTION SCORES AT SIX WEEKS AND SIX MONTHS AFTER HIP FRACTURE COMPARED WITH BASELINE BY DEMOGRAPHIC AND BEHAVIORAL FEATURES

Baseline Factor		Baseline Function		6 Week Function		6 Month Function		% change (B to 6 wk)		% change (B to 6 mo)	
		N	mean	N	mean	N	mean	N	mean	N	mean
I. DEMOGRAPHICS											
AGE	85+	22	7.59	16	3.19	15	4.80	16	60.00	15	40.06
	75-84	60	7.67	43	4.21	45	4.40	43	47.23	45	42.98
	65-74	36	7.58	25	3.84	23	5.22	23	52.31	21	33.96
GENDER	Male	33	7.88	18	3.50	18	4.94	17	56.87	17	37.66
	Female	85	7.53	66	4.02	65	4.63	65	49.65	64	40.75
INSTITUTIONALIZED	Yes	22	5.32**	18	1.83	15	3.07**	16	71.84**	13	50.41
	No	95	8.17	65	4.43	67	5.06	65	46.84	67	38.27
RACE	NW	14	8.07	9	3.44	10	5.30	9	55.15	10	32.23
	WH	103	7.54	74	3.93	72	4.58	72	50.80	70	41.37
EDUCATION	≤8 yr	60	7.95	41	3.42†	39	4.41	41	58.33*	39	44.46
	9+	51	7.33	36	4.56	38	5.00	34	41.14	36	36.21
II. BEHAVIORS											
ALCOHOL	9+oz/mo	17	7.41	11	5.18	12	5.33	11	34.45	12	28.57
USE (oz/mo)	1-8	27	8.15	18	4.06	15	5.73	18	52.69	15	32.57
	0	70	7.40	52	3.60	52	4.23	50	53.70	50	44.74
SMOKING	Current	26	8.00	17	5.12	17	6.12	16	36.55	16	27.28
	Quit	26	7.73	18	4.67	17	5.12	17	42.18	16	34.29
	Never	65	7.40	48	3.15	48	4.00	48	59.42	48	46.52

† one point for each item performed with no help or mechanical assistance only
‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 13b: MEAN FUNCTION SCORES (0N 0-10 SCALE)† AND MEAN PERCENTAGE DECLINE IN FUNCTION SCORES AT SIX WEEKS AND SIX MONTHS AFTER HIP FRACTURE COMPARED WITH BASELINE BY PHYSICAL AND MENTAL FUNCTION

Baseline Factor		Baseline Function		6 Week Function		6 Month Function		% change (B to 6Wk)		% change (B to 6 Mo)	
		N	mean	N	mean	N	mean	N	mean	N	mean
III. PHYSICAL											
COMPLICATIONS	2+	18	7.72‡	10	4.90*	12	5.17‡	10	36.98	12	35.85
(# in hospital)	1	35	8.31	25	4.76	24	5.54	25	44.86	24	35.14
	0	65	7.23	49	3.27	47	4.15	47	57.50	45	43.88
SITE	Fem neck	44	7.50	36	4.14	31	5.03	35	48.05‡	30	37.07
	Troch	58	7.71	39	3.36	43	4.30	38	60.02	42	46.53
	Subtroch	5	6.60	4	4.75	3	4.67	4	23.81	3	20.63
COMORBIDITY	2+	40	6.78**	24	3.75	23	4.61	22	46.30	21	33.59
(# diagnoses)	0-1	78	8.06	60	3.97	60	4.73	60	52.92	60	42.38
BASELINE FUNCTION	0-6	25	4.20**	18	1.44**	16	2.69**	16	72.71**	14	47.62‡
(0-10 scale)	7-8	41	7.41	30	4.50	31	5.26	30	40.06	31	30.01
	9-10	52	9.44	36	4.64	36	5.11	36	50.80	36	45.86
IV. MENTAL											
MENTAL STATUS	4+ err	27	6.93*	22	2.00**	19	3.16**	21	72.95**	18	56.93**
(# errors on SPMSQ)	0-3	83	7.98	57	4.81	58	5.40	57	41.26	58	32.53
DEPRESSION	16+	22	6.68**	15	3.40	14	4.79	15	52.88	14	30.55
(CESD score)	<16	84	8.05	61	4.25	61	4.82	60	48.39	60	40.98

† one point for each item performed with no help or mechanical assistance only
‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 13c: MEAN FUNCTION SCORES (ON 0-10 SCALE)† AND MEAN PERCENTAGE DECLINE IN FUNCTION SCORES AT SIX WEEKS AND SIX MONTHS AFTER HIP FRACTURE COMPARED WITH BASELINE BY SOCIAL NETWORKS AND SUPPORT

Baseline Factor		Baseline Function		6 Week Function		6 Month Function		% change (B to 6Wk)		% change (B to 6 Mo)	
		N	mean	N	mean	N	mean	N	mean	N	mean
V. SOCIAL SUPPORT											
NETWORK SIZE	0-4	40	7.85	28	4.39	30	5.03	28	44.67	30	37.95
	5-7	33	7.79	23	4.43	22	4.73	23	47.71	22	43.48
	≥8	36	7.78	25	3.56	25	4.52	24	54.97	24	39.58
EMOTIONAL SUPPORT	no need	21	7.90	14	5.29	13	5.77	14	34.34	13	25.44‡
	0 source	13	7.23	11	3.49	11	3.91	10	55.04	10	54.89
	1+ source	74	7.78	52	3.90	52	4.65	52	51.98	52	40.57
INSTRU-MENTAL SUPPORT	no need	8	6.75	7	3.57	7	4.71	7	54.42	7	38.55
	0 source	11	8.55	8	3.00	8	4.38	8	64.73	8	47.36
	1+ source	90	7.74	62	4.29	62	4.82	61	46.48	61	38.73
MARITAL STATUS	non married	94	7.54	68	4.10	67	4.85	66	47.53‡	65	37.44‡
	married	21	8.19	13	3.08	13	3.92	13	66.71	13	55.20
SOCIAL ACTIVITY (0-7 score)	0-1	51	7.27	38	3.24*	38	4.32	36	58.04‡	36	42.44
	2+	62	7.87	42	4.60	41	4.98	42	43.92	41	38.62

† one point for each item performed with no help or mechanical assistance only
‡ $p < .10$
* $p < .05$
** $p < .01$

TABLE 14: MULTIPLE LINEAR REGRESSION: BASELINE FACTORS SIGNIFICANTLY ASSOCIATED WITH PHYSICAL FUNCTION (ON A 0-10 SCALE) AND PERCENTAGE CHANGE IN FUNCTION AT SIX WEEKS AND SIX MONTHS

BASELINE FACTOR	Six Week Function		Six Month Function	
	P	β coefficient	P	β coefficient
Mental Status (increasing # errors)	.047	-.39	.017	- .41
Physical Function (0-10 scale)	.001	.61		
Smoking (current, former, never)			.020	-1.10
	% Change Baseline to Six Weeks		% Change Baseline to Six Months	
	P	β coefficient	P	β coefficient
Mental Status	.044	5.57	.008	6.08

DISCUSSION

This study demonstrated that the potentially devastating consequences of hip fractures -- death, long-term institutionalization, and loss of function -- occurred frequently in a prospectively-followed cohort of elders. Death within six months occurred in 18.3% of the 120 individuals who sustained hip fractures. This figure is well within the range of the previous studies outlined in Table 1. Most of those that showed six month mortality figures reported 12.6% - 21.5% (the outlier was Baker [8] who reported a 44% mortality at six months, but did not provide much description of the baseline characteristics of the 50 consecutive hip fracture patients studied). In terms of risk factors for death, the present study found male gender, poor mental status, a high number of comorbid diagnoses and complications, and the site of fracture to be significantly associated with death in bivariate and multivariate analyses (comorbid diagnoses were associated in bivariate analysis only). The first three of these are commonly cited risk factors, noted in most of the studies outlined in Table 1. Postoperative complications were cited as a risk factor for death in only one study (13) in Table 1, at least in part because the others did not even assess this feature. Site of fracture was evaluated in four of these studies (12,13,15,16), all of whom found no significant difference between groups (femoral neck versus intertrochanteric). One possible explanation for this discrepancy is that the severity of illness differed by site, which is suggested by bivariate analyses stratified by comorbidity in the present study, where site was no longer significantly associated with death. Unfortunately, insufficient information is available on severity of fractures, types of repair, and severity of comorbid illnesses and

postoperative complications to definitively determine the reasons for the group differences.

The percentage of patients still requiring institutionalization at six months in this study (37.3%) is compatible with the range (13 - 39%) reported by other studies that assessed continued institutionalization at this time point (18, 21, 23). Comparison between studies is difficult because the patient populations differ. In this study, all individuals lived in the community at the inception of the cohort, but at the time of the fracture 18.5% of those sustaining hip fractures resided in nursing homes. All individuals in nursing homes prior to the fracture who survived (15 of 15) remained institutionalized at six months (along with 16 of 67 [23.7%] individuals who were living in the community prior to the fracture, but were institutionalized afterward). The other three studies excluded patients who were institutionalized at baseline. In addition, Bonar (23) only assessed patients who were community-living at baseline and who were discharged to a nursing home after the fracture. Thus, both figures (37.3% overall and 23.7% of community-living) reported for the present study are within the range of previous studies. In terms of risk factors for long-term institutionalization, these population differences may account for the discrepancies between studies, as might differences in variables assessed. Neither Ceder (22) nor Bonar (23) included patients institutionalized at baseline, leaving poor mental status as the only risk factor that can be compared. Ceder did not assess mental status directly as a risk factor, whereas Bonar did and found it to be significantly associated, but orientation during the hospitalization was assessed, not prefracture mental status. This difference in timing may also explain the lack of certain associations in the present study compared with the other two studies, since ambulation

and ADL performance after the fracture and in-hospital therapy and family visits were found to be significantly associated in at least one of these studies, but were not addressed in the present one. Ceder found high comorbidity and living alone to be associated with long-term institutionalization, while Bonar also found old age associated. These three factors were assessed in the present study, but were not significantly associated.

The same difficulties noted above in trying to compare the present study to previous ones (different populations, different risk factors tested) for death and institutionalization are also applicable when function is the outcome of interest. These are complicated to an even greater degree by the different definitions of function and recovery of function used in different studies. Tables 9 - 12 depict a greater magnitude of functional decline than described in previous studies, even if mechanical assistance is allowed for the performance of basic ADL. At six months, only 6% returned to baseline function, which increased to 14.5% if mechanical assistance was allowed (mechanical assistance was used primarily for walking across a room and transferring). Cobey (24) described a 23.6% complete and 52.8% (in addition) partial recovery of walking, bathing, toileting, dressing, and transferring at six months. Again, these patients were very high functioning at baseline so a higher degree of recovery might be expected. Mossey (17, 28), in a similarly high functioning group, found that 28% returned to baseline in 5 of 7 activities (bathing, dressing, shopping, pulling objects, carrying objects, and ambulation). Even in studies where patients did not have such high baseline function, a less prominent decline was detected than in the present study. Thus, Katz (26) found that 43% of consecutive patients in a rehabilitation facility had complete recovery

of ADL performance. Magaziner (27) noted that 40% returned to prefracture walking levels and 25% to prefracture ADL levels at two months, with substantial additional improvements by six months. However, they relied heavily on proxy interviews for both baseline and follow-up assessments. They claim this method is reliable for determining "facts and observable behaviors," but it may have some bearing on assessing change in function.

The substantial decline in very high functioning individuals depicted in Tables 9 - 12 is another feature seldom mentioned in other studies. Of course, such a decline is implicit in studies that start with only high fuctioning individuals. Mossey (17) mentions that 23% of subjects did not return to baseline function in at least four of seven items assessed. Less than one quarter of subjects in Cobey's study (24) sustained a decline sufficient to affect lifestyle. In the present study, nearly two thirds of high functioning individuals at baseline (who scored 7 - 10 on the 10 point scale) were low functioning (0 - 3) at six weeks and nearly half were low functioning at six months. If the use of mechanical assistance was allowed, this changed to one third and one quarter, respectively. Nevertheless, this represents a profound decline for individuals who were doing very well prior to the fracture.

Additional factors that may affect comparison between studies are the actual activity items assessed and the means for assessment or scoring. The first issue is illustrated by comparing Cobey's (24) results using a five item basic ADL scale and noting a 23.6% complete recovery to Katz (26) who found a 43% complete recovery at six months using a six item ADL scale to the present study which used a 10 item scale which included all the above items plus ambulation across a room and some higher level

activities and found a 6% complete recovery. Some authors who have assessed a wider range of activities have separated them into distinct scales to demonstrate the expected hierarchy in terms of degree of difficulty of performance and the expected greater degree of loss in more difficult items. Thus, Magaziner (27) found the following recovery rates at two months: walking 40%, ADL 25%, and IADL 18%. Similarly, Jette (25) noted recovery of baseline levels in: indoor walking 53-79%, outdoor walking 50-54%, stair climbing 49-54%, ADL 33%, IADL 21%, social/role items 26%. In the present study a similar gradation is apparent if items are analyzed individually rather than as a 10 item scale. Thus, there is a tremendous decline in activities such as stair climbing (57% of survivors performed at baseline, 9% at six months) and walking one half mile (39% at baseline, 7% at six months). Yet, there is also a substantial decline in more basic activities which is partially mitigated by allowing the use of mechanical assistance. Dressing could be performed by 86% of survivors at baseline, but by 48% at six months. Transfers could be performed independently by 88% of survivors at baseline, but by 33% at six months. Whereas 73% could walk across a room independently at baseline, only 14% could at six months. These latter figures can be compared to Magaziner(27), who noted that 87% of survivors were independent in ambulation at baseline and 54% were at one year (since they also found no substantial change in function from six months to one year, these outcome time points should be comparable). This type of analysis also illustrates the other major point, that for certain activities there is a substantial difference in performance rates depending on whether the use of mechanical assistance is allowed. This is especially true for transferring and walking across a room where the six month rates improve from 33% to 69% and from 14% to 73%, respectively, among survivors

when the use of mechanical assistance is allowed. This distinction is apparent in the work of Katz (26) where 24% had complete and 46% had partial recovery of ambulation at six months and Cobey (24) who found a 24% complete and 53% partial recovery of ADL function at six months where "complete" was a score of 10 (two points for independent, one point for minor assistance on each of five items) and "partial" was a score of 8 or 9.

In summary, differences in patient populations, sources of information, function items assessed, and the method of assessment or scoring may all affect the ability to interpret and compare studies of alteration in function after hip fracture. However, there did appear to be a more prominent decline in function in this cohort compared to previous studies, although at least some of this may be due to an increased need for mechanical assistance.

The ability of baseline factors to predict functional decline in this study was limited. The major reasons for this limitation were likely the prominent functional decline among the majority of subjects and the consequent lack of an adequate sample size (power) to be able to detect a difference between those who did well and those who did poorly. The only consistent predictor was poor mental status, which was significantly associated with absolute and percentage decline in function at both six weeks and six months in bivariate and multivariate analyses. The other two factors which were associated in most bivariate analyses and at least one multivariate model were baseline physical function and smoking. Baseline mental and physical function are commonly cited risk factors for functional decline in previous studies and the present study supports that data. Smoking status has not been assessed as a risk factor in previous studies of change

in function. The reason for its inclusion here is that some studies have reported smoking as a risk factor for osteoporosis and the occurrence of hip fracture and it could be postulated that smoking might contribute to comorbidity and postoperative complications and, therefore, lead to poor recovery. Also, some authors (25) have advocated using smoking cessation as the basis for preventive interventions in hip fractures. Actually, the opposite effect was detected in the present study, with individuals who smoked having higher baseline function, as well as less decline, at six weeks and six months. A possible explanation is that there may be a "survivor" effect, such that individuals who smoke, but reach this age range and continue to live in the community, may represent a more hearty group than their nonsmoking peers. Other factors associated in different analyses, but not consistently, were nursing home residence, complications, education, and social activity levels. Individuals in nursing homes, with low education levels, or with low social activity levels at baseline tended to have a greater decline at six weeks, although this decline was less apparent at six months for the latter two factors. One could postulate that individuals in nursing homes and those with few social activities were less functional to begin with and therefore more likely to decline after the fracture, if indeed baseline function is an important predictor of outcome function. Low education levels may reflect poverty and lack of access to rehabilitation or social services after the fracture and a more delayed recovery. One might expect that individuals with postoperative complications would have a slower and more prolonged recovery. The data here suggest the opposite, that individuals with complications actually start out and end up at higher levels of function. This may be because of the close relationship of complications to mortality after hip fracture described above. Thus, it may be that the development of

complications puts an individual at increased risk of death, but if they manage to survive it does not have an adverse effect on function. In summary, the baseline factors which predicted functional decline were similar to those described by previous studies which assessed those factors. However, not all previously described risk factors were detected in this study, at least in part due to the lack of sufficient sample size to detect an association given the magnitude of decline in function.

As outlined in the background section, there were numerous strengths of this study. This study was unique in its use of a prospectively followed cohort and in its assessment of all three major potential adverse outcomes after hip fracture: death, institutionalization, and change in function. Extensive data was collected on baseline conditions and the collection of this information prior to the fracture eliminated the possibility of recall bias, especially as it might apply to physical and mental function. There were, however, a number of problems with the study. Given the magnitude of functional decline, an insufficient number of subjects were available to adequately assess the range of potential predictors of this decline. Thus, poor mental status is clearly a very strong predictor of decline, but little can be concluded about the other factors which showed trends or were inconsistently associated. The collection of data prior to the fracture also had its down side, since there was a varying lag time between the most recent interview and the event. On average, this lag time was approximately six months. However, information on some baseline variables came from the three year interviews (as described in the Methods section) and would therefore have a larger lag time between data collection and the event. Thus, it is possible that patients' status changed during that interval. Also, several baseline factors lacked additional information that would have

made interpretation of their role more clear. For instance, there was no information on the severity of baseline comorbid illnesses or postoperative complications in the hospital. There was also no information available on other potentially important function items, such as IADL (other than housework). In addition, there were no physical performance data which may have given a more accurate and objective barometer of how capable subjects were before and after the fracture than would self-reported data.

CONCLUSIONS

In this prospectively followed community-living (at its inception) cohort, 120 hip fractures occurred in a six year period. Adverse outcomes such as death (18.3%) and institutionalization at six months (37.3% of survivors) occurred frequently, but were within the ranges described by previous studies. Baseline predictors of death (gender, mental status, complications, site of fracture) and institutionalization (nursing home residence at baseline, mental status) were also consistent with previous studies. There was also a profound decline in function, with only 6% returning to their baseline level of performance on a scale of 10 items selected to reflect a range of activity expected in a community-living cohort (which improved to 15% if mechanical assistance was allowed). There was little recovery of function between six weeks and six months after the fracture. Comparison of these results with previous studies is made difficult by the different populations evaluated and the different scales and scoring methods used to grade function. However, even when similar definitions and scoring methods were used, it appeared that the decline detected in this study was greater than previous studies had shown. Relatively little can be said about predictors of functional decline from this study, however, except that poor mental status is a very strong and consistent predictor of decline.

The strengths of the study include: the use of prospectively collected data with information on the baseline status of subjects collected prior to the fracture rather than retrospectively like previous studies; the lack of selection criteria so that outcomes were assessed in all cohort members sustaining a hip fracture, which makes the results more generalizable than studies which only examined high functioning individuals; and the use

of a broad range of items to assess physical function before and after the fracture rather than focusing on just ambulation or basic ADL.

There are a number of potential applications of this data and areas where further work needs to be done. A number of potentially intervenable risk factors for mortality were detected. Attention to postoperative complications and perioperative mental status and management of comorbid illnesses may be helpful. In designing future studies, attention must be paid to following a large enough population for a long enough time to accrue a sufficient number of subjects to adequately assess risk factors. Also, more information on potential risk factors in the perievent period must be obtained. In the design of future intervention studies, attention should be paid to the risk factors mentioned above. Also, this study demonstrated that with the profound decline in function detected, there is considerable room for improvement in the management of hip fracture patients.

SUMMARY

The present study detected the frequent occurrence of adverse events such as death, institutionalization, and alteration in function after hip fracture. This study confirmed the previously reported predictors of mortality, but detected relatively few predictors of institutionalization or decline in function. The predictors of death differed from the predictors of the other two adverse outcomes. The decline in function detected was substantial and greater than previous studies reported, even when mechanical assistance was allowed, although comparison between studies is difficult.

Overall, the catastrophic nature of hip fractures was confirmed. Nearly one fifth died after the fracture and virtually all the rest had a decline in function (many had a profound decline) with over one third of survivors institutionalized at six months. In order to reverse this devastation, innovative and aggressive approaches to the care of hip fracture patients must be taken.

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